

REMARKS

Claims 1-12 and 15-43 are pending in this application. Claims 13, 14 and 44 - 54 have been canceled without prejudice or disclaimer. Claims 1, 3, 10 - 12, 42 and 43 have been amended herewith.

Applicants believe that the claim amendments are fully supported by the specification. A fiber diameter not less than $0.5 \mu\text{m}$ but less than $2 \mu\text{m}$ is supported by Fig. 11. The elements in claim 10 of "forming a carbon fiber aggregate by aggregating and compressing said non-galvanic corrosive carbon fibers to a bulk density of from $(3 - b) \text{ kg/m}^3$ to $(10 - b) \text{ kg/m}^3$ " and "spraying a thermosetting resin solution to said carbon fibers so that the amount of a thermosetting resin in relation to the amount of the carbon fiber aggregate is made to be b, where b is an arbitrary number fixed so that the bulk density is positive and the relationship $0.3 \leq b \leq 4$ is satisfied" are supported by description on page 34, lines 3-18 and on page 35, line 23 to page 36, line 6 ($b/3$ to $b/10 = 0.1$ to 0.4). The elements in claim 11 of "forming a carbon fiber aggregate having a bulk density less than 1.3 kg/m^3 by aggregating said non-galvanic corrosive carbon fibers" and "curing the thermosetting resin by compressing and heating the carbon fiber aggregate sprayed with the thermosetting resin solution to bond contact points of said carbon fibers and thereby manufacture a three dimensional structure of carbon fibers having a bulk density of from 3 kg/m^3 to 10 kg/m^3 " are supported by description on page 33, lines 4-20, and by the original claim 13, for example.

Claims 12 and 42 are objected to because of informalities.

The objections are overcome by the amendment to the claims. Claim 42 has been canceled without prejudice or disclaimer. Claim 12 has been amended to remove the phrase "characterized by."

Claims 1-54 are rejected under 35 USC §103(a) as being unpatentable over McCullough, Jr. et al. in view of Takemura et al. (US 5,254,396).

The rejection is overcome by the amendments to the claims. Claims 13, 14 and 44 - 54 have been canceled without prejudice or disclaimer. Independent claims 1 and 10 have been amended, and claim 11 has been amended to be independent.

In independent claims 1, 10, and 11, carbon fibers are limited to anisotropic pitch-based carbon fibers having an average fiber diameter of $0.5 \mu\text{m}$ and an average fiber length of 1 mm to 15 mm.

McCullough, Jr. et al. do not teach anisotropic pitch-based carbon fibers as recited in the claims. Although McCullough, Jr. et al. do teach carbon fibers having a fiber diameter of 2-25 μm , carbon fibers having a fiber diameter of less than $2 \mu\text{m}$, a limitation recited in the claims, are not taught.

In Takemura et al., a process is taught for producing a high bulk density carbon fiber structure by piling up sheets of infusibilized fiber of anisotropic pitch type, which is derived from petroleum, blended with a phenolic resin fiber, entangling the piled-up sheets to form a fiber laminate, and carbonizing the fiber laminate (abstract; col. 8, lines 13-15).

The production method of the present claims, however, differs from that of Takemura et al. The essential constituting elements of the resulting carbon fiber structures also differ. The differences are summarized below in Table 1.

As shown in Table 1, the softening point of the anisotropic pitch used in the examples of the present application, which is made from the condensed polycyclic hydrocarbon, is 280°C, and that of Takemura et al. is from 275°C-284°C. Therefore, the respective raw materials resemble one another. In the present claims, however, spun fibers produced using the anisotropic pitch are subject to a carbonizing treatment at a temperature of at least 550°C but lower than 800°C (Claims 10, 11). By contrast, in Takemura et al., carbonizing treatment is carried out in the range of 1000°C-2000°C.

As is appreciated from Fig. 1 of the present application, when the carbonizing temperature is 800°C or higher, the galvanic current markedly increases, causing greater degrees of galvanic corrosion. Based on this evidence, it is shown that the carbon fibers of Takemura et al. that undergo carbonizing treatment in the range of 100°C-2000°C are not non-galvanic corrosive.

As is appreciated from Fig. 2 of the present application, when the carbonizing temperature is 800°C or higher, there is no longer improvement in elongation. In addition, as is appreciated from Figs. 3 and 5, there is a close relation between the carbonizing temperature and the tensile strength of the thermal-acoustic insulation material and the compression recovery rate, maximum values for the tensile strength and the compression recovery rate being around a carbonizing temperature of 700°C and minimum values being around a carbonizing temperature slightly above 800°C. Carbon fibers that are capable of producing a thermal-acoustic insulation material cannot be obtained when carbonizing treatment is carried out at a high temperature of 1000°C-2000°C.

Thus, the carbon fibers of Takemura et al. and the carbon fibers of the present application have different physical properties.

The carbon fiber structure of Takemura et al. is produced by piling up sheets of an infusibilized, or infusibilized and slightly carbonized fiber of anisotropic pitch mixed with a phenolic resin fiber (col. 2, line 65 to col. 3, line 3; col. 8, lines 23-37; claim 1 etc.). By contrast, according to the invention of the present application, non-galvanic corrosive carbon fibers are accumulated and a binder is sprayed and cured by heating to form the structure.

Such a difference in production method has the following significance. In the carbon fiber structure of Takemura et al., the phenolic resin fiber, which is a binder, is also carbonized, whereby the structure is formed of only carbonized substances. By contrast, in the thermal-acoustic insulation material of the invention of the present application, the thermosetting resin, which is a binder, is not carbonized, but rather only cured by heating.

Thus, while in Takemura et al., a carbonized material (carbon fiber) is combined with a carbonized material (carbon fiber), in the present application, a carbonized material (carbon fiber) is bonded with an organic material (binder), making the material composition of the structures different.

It is of course the case that the "heating" in "curing the thermosetting resin by heating" of claims 10 and 11 refers to heating to the thermosetting temperature, not the carbonizing temperature. In the present application, for example, heating is carried out at a temperature of 150°C - 250°C when the binder is a phenolic resin (page 36, lines 6-8 of the specification), a temperature at which the phenolic resin is not carbonized.

In addition, the carbon fiber structure of Takemura et al. has a high bulk density of 130-160 kg/m³. By contrast, the structure of the present application has an extremely coarse bulk density of 3-10 kg/m³, demonstrating that the structures are different.

As shown by the above explanation, the present application is like that of Takemura et al. only in that anisotropic pitch-based carbon fibers are utilized. While the structure of Takemura et al. is a rigid structure composed of only carbon substances and having a high bulk density, the structure of the present application is a soft structure composed of a carbon material and an organic material bonded to the carbon material and having a coarse bulk density. Thus the material composition and structure of each differ.

It would therefore be difficult to reach the invention of the present application from Takemura et al., and the present application is unobvious over Takemura et al.

Even if McCullough, Jr. et al. and Takemura et al. were combined, the configuration of the present invention such that "a multiplicity of anisotropic pitch-based carbon fibers having an average fiber diameter of not less than 0.5 μm but less than 2 μm and an average fiber length of 1 mm to 15 mm, said carbon fibers being non-galvanic corrosive and being bonded by a thermosetting resin at contact points of said carbon fibers so as to form a carbon fiber aggregate having a bulk density of from 3 kg/m³ to 10 kg/m³; wherein said thermal-acoustic insulation material is non-galvanic corrosive" would not be reached.

Moreover, even if all of the manufacturing methods disclosed in McCullough, Jr. et al., and Takemura et al. were combined, claim 10 of the present invention, which includes claimed elements (a)-(e) shown below, and claim 11 of the present invention, which includes claimed elements (f)-(j)

shown below, would not be reached.

Thus, claims 1, 10 and 11 of the present application are unobvious over a combination of McCullough, Jr. et al. and Takemura et al., and likewise, claims dependent on these claims are also unobvious.

Claimed Elements of Claim 10

- (a) producing spun fibers having an average fiber diameter less than $2 \mu\text{m}$ and an average fiber length of 1 mm to 15 mm;
- (b) manufacturing non-galvanic corrosive carbon fibers by infusibilizing spun fibers and thereafter carbonizing said carbon fibers at not lower than 550°C but lower than 800°C ;
- (c) forming a carbon fiber aggregate by aggregating and compressing said non-galvanic corrosive carbon fibers to a bulk density of from $(3\text{-}b) \text{ kg/m}^3$ to $(10\text{-}b) \text{ kg/m}^3$;
- (d) spraying a thermosetting resin solution to said carbon fibers so that the amount of a thermosetting resin in relation to the amount of the carbon fiber aggregate is made to be b, where b is an arbitrary number fixed so that the bulk density is positive and the relationship $0.3 \leq b \leq 4$ is satisfied; and
- (e) curing the thermosetting resin by heating the carbon fiber aggregate sprayed with the thermosetting resin solution to manufacture a three dimensional structure of carbon fibers wherein said carbon fibers are bonded at contact points thereof, said three-dimensional structure having a bulk density of from 3 kg/m^3 to 10 kg/m^3 .

Claimed Elements of Claim 11

- (f) producing spun fibers having an average fiber diameter less than 2 μm and an average fiber length of 1 mm to 15 mm by heating and melting anisotropic pitch obtained by polymerizing condensed polycyclic hydrocarbon, then discharging a melted matter out of a spinning nozzle and at the same time, blowing a heated gas from around the spinning nozzle in the same direction in which the melted matter is discharged;
- (g) manufacturing non-galvanic corrosive carbon fibers by infusibilizing spun fibers and thereafter carbonizing said carbon fibers at not lower than 550°C but lower than 800°C;
- (h) forming a carbon fiber aggregate having a bulk density less than 1.3 kg/m³ by aggregating said non-galvanic corrosive carbon fibers;
- (i) spraying a thermosetting resin solution to the carbon fiber aggregate; and
- (j) curing the thermosetting resin by compressing and heating the carbon fiber aggregate sprayed with the thermosetting resin solution to bond contact points of said carbon fibers and thereby manufacture a three dimensional structure of carbon fibers having a bulk density of from 3 kg/m³ to 10 kg/m³.

Table 1

	Pitch raw material	Softening temperature of pitch	Carbonizing Temperature	Bulk density of carbon fiber structure	Other
<u>*Example 1</u>		<u>275°C</u>	<u>1,600°C</u>	<u>130 kg/m³</u>	binder (phenolic resin fiber) is also carbonized.
<u>*Example 2</u>		<u>284°C</u>	<u>2,000°C</u>	<u>160 kg/m³</u>	
*Example 3	petroleum	284°C	1,000°C	not recorded	
Present application	condensed polycyclic hydrocarbon	280°C	550°C or more but less than 800°C (Claim 10, 11)	3-10 kg/m ³ (Claim 1, 11)	binder is not carbonized.

*Takemura et al.

Note: In column 9, lines 14-20 of Takemura et al., it is described that when anisotropic pitch type fiber is used alone, bulk density is 48 kg/m³ and inter-web debonding is observed during the course of the carbonization treatment.

Applicants therefore believe that pending claims 1-12 and 15-43 are novel and non-obvious over McCullough, Jr. et al. and Takemura et al. (US 5,254,396), taken separately or in combination.

A marked-up version showing the changes made by the present amendment is attached hereto as "Version with Markings to Show Changes Made."

AMENDMENT UNDER 37 CFR §1.111
Fumikazu MACHINO et al.

U.S. Patent Application S.N. 09180,432
Attorney Docket No. 981361

If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact Applicant's undersigned agent at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

In the event that this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees which may be due with respect to this paper, may be charged to Deposit Account No. 01-2340.

Respectfully submitted,

ARMSTRONG, WESTERMAN & HATTORI,, LLP


Daniel A. Geselowitz, Ph.D.
Agent for Applicants
Reg. No. 42,573

Atty. Docket No. 981361
Suite 1000
1725 K Street, N.W.
Washington, D.C. 20006
Tel: (202) 659-2930
DAG/plb
Enclosures: Version with Markings to Show Changes Made
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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

Please amend claims 1, 3, 10 - 12, 42 and 43 as follows:

1. (Three Times Amended) A thermal acoustic insulation material comprising:

a multiplicity of anisotropic pitch-based carbon fibers having an average fiber diameter of not less than $0.5 \mu\text{m}$ to but less than $5.2 \mu\text{m}$ and an average fiber length of 1 mm to 15 mm, said carbon fibers being non-galvanic corrosive and being bonded by a thermosetting resin at contact points of said carbon fibers so as to form a carbon fiber aggregate having a bulk density of from 3 kg/m^3 to 10 kg/m^3 ;

wherein said thermal-acoustic insulation material is non-galvanic corrosive.

3. (Three Times Amended) A thermal-acoustic insulation material as in claim 1, wherein said anisotropic pitched-based carbon fibers have an average fiber diameter of from $0.5 \mu\text{m}$ to 2.0 $1.0 \mu\text{m}$.

10. (Four Times Amended) A method of manufacturing a thermal-acoustic insulation material, comprising the steps of:

a spinning step of producing spun fibers having an average fiber diameter less than $2 \mu\text{m}$ and an average fiber length of 1 mm to 15 mm by heating and melting anisotropic pitch obtained by polymerizing condensed polycyclic hydrocarbon, then discharging a melted matter out of a spinning nozzle and at the same time, blowing a heated gas from around the spinning nozzle in the same

direction to which the melted matter is discharged;

~~a carbon fiber manufacturing step of manufacturing non-galvanic corrosive carbon fibers by infusibilizing spun fibers and thereafter carbonizing said carbon fibers at not lower than 650°C. 550°C. but lower than 750°C. 800°C.;~~

forming a carbon fiber aggregate by aggregating and compressing said non-galvanic corrosive carbon fibers to a bulk density of from (3 - b) kg/m³ to (10 - b) kg/m³;

~~a spraying and accumulating step of accumulating said non-galvanic corrosive carbon fibers onto a plane so as to form a material, while spraying a thermosetting resin solution to said carbon fibers so that the amount of a thermosetting resin in relation to the amount of the carbon fiber aggregate is made to be b, where b is an arbitrary number fixed so that the bulk density is positive and the relationship 0.3 ≤ b ≤ 4 is satisfied; and~~

curing the thermosetting resin by heating the carbon fiber aggregate sprayed with the thermosetting resin solution to manufacture a three dimensional structure of carbon fibers wherein said carbon fibers are bonded at contact points thereof, said three-dimensional structure having a bulk density of from 3 kg/m³ to 10 kg/m³ a heat-forming step of forming said material of accumulated carbon fibers by applying heat so that contact points of said carbon fibers are bonded.

11. (Amended) A method of manufacturing thermal-acoustic insulation material as in claim 10, wherein said spraying and accumulating step comprising an accumulating step comprises an accumulating step of accumulating said non-galvanic-corrosive carbon fibers as to form a wool-like material of accumulated carbon fibers and a spraying step of spraying a thermosetting resin solution

~~to said wool-like material of accumulated carbon fibers, comprising the steps of:~~

producing spun fibers having an average fiber diameter less than 2 μm and an average fiber length of 1 mm to 15 mm by heating and melting anisotropic pitch obtained by polymerizing condensed polycyclic hydrocarbon, then discharging a melted matter out of a spinning nozzle and at the same time, blowing a heated gas from around the spinning nozzle in the same direction in which the melted matter is discharged;

manufacturing non-galvanic corrosive carbon fibers by infusibilizing said spun fibers and thereafter carbonizing said spun fibers at not lower than 550°C. but lower than 800°C.;

forming a carbon fiber aggregate having a bulk density less than 1.3 kg/m³ by aggregating said non-galvanic corrosive carbon fibers;

spraying a thermosetting resin solution to the carbon fiber aggregate; and
curing the thermosetting resin by compressing and heating the carbon fiber aggregate sprayed with the thermosetting resin solution to bond contact points of said carbon fibers and thereby manufacture a three dimensional structure of carbon fibers having a bulk density of from 3 kg/m³ to 10 kg/m³.

12. (Amended) A method of manufacturing a thermal-acoustic insulation material as in claim 10 11, wherein in said step of forming a carbon fiber aggregate, a method of accumulating said carbon fibers in said spraying and accumulating step or said accumulating step is characterized by accumulating said carbon fibers by dropping said non-galvanic corrosive carbon fibers are opened by the air and dropped from a height of at least 100 cm or higher onto a plane.

42. (Amended) A method of manufacturing a thermal-acoustic insulation material as in claim ~~11~~ 10, wherein a method of accumulating said carbon fibers in said spraying and accumulating step or said accumulating step is characterized by accumulating said carbon fibers by dropping said carbon fibers opened by the air from a height of at least 100 cm or higher onto a plane a temperature of carbonizing the spun fibers is not lower than 650°C. but lower than 750°C.)

43. (Twice Amended) A method of manufacturing a thermal-acoustic insulation material as in claim ~~12~~ 11, wherein ~~said material of accumulated carbon fibers has a bulk density of 1.3 kg/m³ or lower~~ a temperature of carbonizing the spun fibers is not lower than 650°C. but lower than 750°C.)